Evaluation of fungicides for control of powdery mildew (*Leveillula taurica*) on tomato, 2012

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This study was conducted in a commercial fresh market tomato field (cv. Bobcat) located in Collegeville, CA. The field was transplanted on July 3rd and furrow-irrigated. Each plot consisted of a single row of tomatoes on a 60-in centered bed and plots measured 35 feet long. The experimental design was a randomized complete block design with four replications. The trial area was managed by the grower similarly to the rest of the field except that no sulfur or mildew fungicides were applied to the test area. Experimental fungicide applications were initiated on August 27th, with the second application following 14 days later and the third application 9 days after the second. At the time of the initial application, powdery mildew was present in the field; however symptoms were not yet apparent in the test area. All fungicides were applied in the equivalent of 44 gallons of water per acre with a CO_2 backpack sprayer (operating at 34 psi at the boom) and a handheld boom with four hollow cone nozzles, two of which were on drops. A non-ionic surfactant (Latron B-1956) was added only when specified (see table 1). Mildew severity and crop health were evaluated from mid-September through harvest in early October. Plots were rated for the percentage of the foliage that was affected by mildew using a 10-point pre-transformed rating scale. No phytotoxicity symptoms were observed in any of the treatments. Powdery mildew developed in the field beginning in late August and progressed quite rapidly to a high level of disease (Fig. 1). There was a high spore load in the air from an adjacent older tomato field. In non-treated areas, the older foliage became completely necrotic while the intermediate foliage was covered with necrotic spots and/or sporulating lesions and the new foliage showed early sporulation or yellow spotting. Mildew severity did vary significantly between treatments on all rating dates, but the greatest degree of separation was with the October 2nd rating (Fig. 2). Under this heavy disease pressure, rotation programs which included Quadris Top, Quintec or Microthiol performed better. On October 1st, a 10-ft section of each plot was hand-harvested and sorted for defects (sunburn and other culls). Fruit yield and levels of sunburn were similar between treatments.

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Table 1. Fungicide programs evaluated, including rates and application timings. Note that rates are presented as formulated product (and a.i.) applied on a per acre basis.

	APPLICATION TIMINGS		
	A	**B**	**C**
Fungicide program	**27-Aug**	**10-Sep**	**19-Sep**
CX-10440 high rate	3 sequential applicatons of 13 oz CX-10440 (0.65 oz polyoxin-D)		
CX-10440	3 sequential applications of 6.5 oz CX-10440 (0.33 oz polyoxin-D)		
Microthiol	3 sequential applicaitons of 20 lb Microthiol (256 oz micronized sulfur)		
Microthiol alt. F9110-1	20 lb Microthiol (256 oz micronized sulfur)	24.4 oz F9110-1* (a.i. not disclosed)	20 lb Microthiol (256 oz micronized sulfur)
Microthiol fb. F9110-1	20 lb Microthiol (256 oz micronized sulfur)	24.4 oz F9110-1* (a.i. not disclosed)	
Microthiol fb. Sonata	20 lb Microthiol (256 oz micronized sulfur)	4 qt Sonata (1.7 oz Bacillus subtilis strain QST 2808)	
Quadris Top alt. Sonata	8 oz QuadrisTop (1.67 oz azoxystrobin + 1.05 oz difenoconazole)	4 qt Sonata (1.7 oz Bacillus subtilis strain QST 2808)	8 oz QuadrisTop (1.67 oz azoxystrobin + 1.05 oz difenoconazole)
Quadris Top alt. sulfur	8 oz Quadris Top (1.67 oz azoxystrobin + 1.05 oz difenoconazole)	20 lb Microthiol (256 oz micronized sulfur)	8 oz QuadrisTop (1.67 oz azoxystrobin + 1.05 oz difenoconazole)
Regalia	3 sequential applications of 1% v/v (1.7 qt) Regalia (2.7 oz extract of R. sachalinensis)		
Regalia fb Regalia + Quadris Top	2 qt Regalia (3.2 oz extract of R. sachalinensis)	1 qt Regalia + 8oz QuadrisTop (1.6 oz extract of R. sachalinensis fb. 1.67 oz azoxystrobin + 1.05 oz difenoconazole)	
Regalia fb. Regalia + Quadris Top	1 qt Regalia (1.6 oz extract of R. sachalinensis)	1 qt Regalia + 8oz QuadrisTop (1.6 oz extract of R. sachalinensis + 1.67 oz azoxystrobin + 1.05 oz difenoconazole)	
Regalia fb. Regalia + Quintec	1 qt Regalia (1.6 oz extract of R. sachalinensis)	1 qt Regalia + 4oz Quintec (1.6 oz extract of R. sachalinensis + 1 oz quinoxyfen)	
Sonata	3 sequential applications of 4 qt Sonata (1.7 oz Bacillus subtilis strain QST 2808)		
Taegro alt. Quadris Top	2.6 oz Taegro* (0.34 oz Bacillus subtilis var. amyloliquefaciens strain FZB24)	8 oz QuadrisTop (1.67 oz azoxystrobin + 1.05 oz difenoconazole)	2.6 oz Taegro* (0.34 oz Bacillus subtilis var. amyloliquefaciens strain FZB24)
Taegro higher rate alt. Quadris Top	5.2 oz Taegro* (0.7 oz Bacillus subtilis var. amyloliquefaciens Strain FZB24)	8 oz Quadris Top (1.67 oz azoxystrobin + 1.05 oz difenoconazole)	5.2 oz Taegro* (0.7 oz Bacillus subtilis var. amyloliquefaciens Strain FZB24)
non-treated control	---	---	---

* asterisk indicates application included non-ionic surfactant Latron B-1956 at 0.25% (v/v)

Table 2. Efficacy of fungicide programs against powdery mildew of tomato (cv. 'Bobcat') caused by *Leveillula taurica* in Collegeville, CA, 2012.

	Powdery mildew severity (% of foliage affected)				Fruit	Sunburn
	18-Sep	26-Sep		2-Oct	biomass	(% fruit
Fungicide program (and timings)[x]		newer lvs	oldest leaves		(tons/ac)	by weight)
Quadris Top (AC) alt. Microthiol (B)	10.9 de	2.5	29.3 de	24.5 f	27.1	28.0
Regalia 2 qt (A) fb Regalia + Quadris Top (BC)	21.8 cde	6.3	31.5 de	25.5 f	30.2	25.0
Regalia 1 qt (A) fb Regalia + Quintec (BC)	21.8 cde	3.8	21.0 e	25.5 f	26.9	15.8
Microthiol (AC) alt. F9110-1 (B)	19.0 cde	5.3	35.5 cde	28.0 ef	29.5	26.3
Microthiol (ABC)	8.1 e	2.5	28.0 de	28.0 ef	25.7	26.0
Quadris Top (AC) alt. Sonata (B)	17.1 cde	9.0	39.3 cde	29.0 ef	27.9	21.0
Microthiol (A) fb. F9110-1 (BC)	25.3 bcd	6.3	46.5 bcd	31.5 ef	31.0	29.0
Taegro higher rate (AC) alt. Quadris Top (B)	25.5 bcd	8.1	57.5 bc	31.5 ef	24.4	27.8
Regalia 1 qt (A) fb Regalia + Quadris Top (BC)	28.0 abc	6.0	46.3 cd	35.3 def	26.5	29.8
Taegro (AC) alt. Quadris Top (B)	31.8 abc	6.3	49.8 bcd	40.0 cdef	26.6	18.5
Microthiol (A) fb. Sonata (BC)	10.9 de	8.1	35.3 cde	42.5 bcde	30.4	25.8
CX-10440 high rate (ABC)	20.3 cde	7.1	46.3 cd	42.8 bcde	31.5	25.8
CX-10440 (ABC)	42.5 a	12.8	89.1 a	50.0 abcd	26.0	34.8
Sonata (ABC)	25.3 bcd	10.0	71.0 ab	53.8 abc	28.8	27.8
Regalia at 1% v/v (ABC)	31.8 abc	12.8	84.8 a	57.5 ab	26.6	30.8
non-treated control	38.8 ab	10.9	93.5 a	65.0 a	27.5	24.8
Mean	23.7	7.3	50.3	38.1	27.9	26.0
LSD (0.05)	16.07	NS	24.6	16.96	NS	NS
CV (%)	47.7	65.0	34.4	31.2	17.6	32.0

x For details on rates and application dates, see table 1.

Means in the same column followed by the same letter are not statistically different, according to Fisher's protected least significant difference test.

NS = result of analysis of variance is not significant

Figure 1. Symptoms on non-treated plants; yellow and/or necrotic spots and sporulation (left) and drying out of older foliage (right)

Figure 2. Range in severity of powdery mildew symptoms on newer fully expanded leaves from various plots within the trial area, October 2, 2012. Bottom middle photo is from a non-treated control plot.